Art. XV.—*Electric Lighting for Mines.*

By Mr. R. E. Joseph.

[Read 11th October, 1883.]

Having for some months past been engaged in arranging several appliances for the electric illumination of our gold mines, I have made a few notes on the matter which I hope may be of interest.

Although at first sight the work of lighting a mine and its workings, both above and below, may appear to be a comparatively easy matter, a careful examination as to the conditions required for its successful maintenance in working order will show that it is not so, and that a system which would prove satisfactory in ordinary places might be extremely unsuitable for mining purposes.

Most of our mines require artificial light on the surface-works all night, and for the underground workings both day and night each week, with scarcely any cessation. The surface-lights are used to illuminate the engine and boiler-house, winding plant, changing house, smithy and brace, and, where crushing plant exists, the battery house and its engine.

Where gas has been available it has been used to a certain extent for the above-named purposes, but as gas in all country districts is high in price it forms a heavy item in the working expenses, consequently we find that the general illuminant used is oil, kerosene, and candles. Neither of these agents gives a good light, and all of them have serious disadvantages which should preclude their use except under most exceptional circumstances.

Oil and kerosene lamps require constant attention; they have to be trimmed and the oil renewed daily, and unless provided with glass chimneys they smoke and are offensive; if chimneys be used, there is a constant breakage, and thereby expense. Candles are, it is true, easily managed, but the light they afford is too feeble for the purposes required on the surface as fixed lights, consequently we see them carried about from place to place, lighting up small areas as required, with, as may be expected, the accompanying waste from the draughts of air. But the most serious disadvantage arising from the use of any of these agents is the danger of grease mixing with the gold or any of the appliances belonging to it, grease of any sort being a source of trouble, and causing a

great waste in the recovery of the gold during the process of amalgamation. In the underground workings generally the principal lights used are oil-lamps at the plats or entrance to the drives, and candles in the crosscuts, levels, and backs. As a rule, a mine has either too little or too much air—that is to say, some of our mines are so badly ventilated that in certain parts a candle will not burn, whilst in other mines the draught of air is so great that it is difficult to keep the candle alight, and under these circumstances about half the candle is wasted by the grease running away. An examination of nearly all our mines shows at once that the arc-light would be unsuitable for surface works and unworkable for below ground, where there are few places large enough to hang an arc-lamp. Most of our drives and levels are some six or seven feet wide, about the same height, and varying from two hundred to eight hundred feet in length; consequently they require a number of small lights only. Above ground arc-lights might be used, but as a number of them would be required (all the places to be lighted being detached), it would be an expensive method not only in its first cost, but in its maintenance. It, therefore, became obvious that the incandescent system of electric light would prove the most suitable for all conditions and circumstances.

In designing and carrying out an electric-light installation at a mine, two or three points require careful consideration.

Deriving an electric current from a dynamo machine, which must be kept in motion during the whole time a light is required, it was found necessary to provide a motor independent of the mining plant.

Where water-power is not available a small steam-engine, of a good working type and sufficiently large enough to do the maximum amount of work required of it, must be provided. This auxiliary engine can, of course, be supplied with steam from the regular boilers in use, thus involving no extra outlay for firing.

Little need be said about the engine—any kind or make will answer, provided it be of an economical type with respect to its steam supply; but it was found an advantage to fit on an extra fly-wheel to ensure its steadiness in running, and special large lubricators to feed the oil for a length of time without stopping the engine. The dynamo machine used is of a special type. Running constantly both day and night, its working parts require to be durable, the armature not too large and heavy, and the speed not too high.

The current it furnishes must not be of too high an electromotive force, for if any shock were felt on taking hold of any bare wire there would be an aversion on the part of the miners to handle or use any of the apparatus, whilst the machines in use have been so arranged that the electromotive force will remain nearly constant, and thus maintain to the same degree of brightness either one or its maximum number of lights without altering the speed of the driving engine.

Too much care cannot be exercised in carrying out this portion of the work, for it must be recollected that the apparatus will be left in charge of those who probably know nothing whatever of electrical matters, and who could not, therefore, know where to look for or to rectify even the slightest fault which might occur. But with properly constructed apparatus and a little training, no difficulty has been experienced by the engine-drivers employed in the mines in maintaining the dynamo machine in an efficient condition.

The surface and underground lights are kept on two circuits, and under the control of two switches. All the lights are enclosed in outer globes of thick glass, the dirt and dust about the places necessitating a covering for the lamps which could be cleaned and handled roughly. In the crushing-rooms flexible springs are used to suspend the lanterns, it being found that the constant vibration to which the lamp was subjected caused the carbon loops to occasionally break off.

Each lamp is controlled by a separate switch and a safety cut-out, whilst a protecting wire guard is necessary in places where the lamp is liable to be struck with quartz or implements. From the engine-house to the shaft overhead conducting wires are used, not necessarily covered with insulating material. These wires end in an iron junction-box, having a main fusible cut-out. Down the shaft the current is lead by an insulated cable constituting the leading wire, and enclosed in a galvanised-iron pipe of suitable conductivity which serves for the return lead. Copper strips soldered over the joints of the pipes ensure an electrical connection. At each plat an iron junction-box is provided, having a safety cut-out leading to the branch wire for the cross-cuts and levels.

These branch wires are smaller but similar to the main, being also enclosed in iron pipes, which serve as the return

wire. At suitable intervals iron boxes are provided, containing a cut-out and coupling by which the lamp can be easily attached.

Each lamp enclosed in an outer glass lantern with protecting wire guard has some 10 feet of flexible conducting wire attached to it, provided with a coupling for attachment to the junction-box. The lantern can then be suspended on the iron tubing in any desired spot. The iron junction-boxes are placed along the cross-cuts and levels at spots selected, and are in excess of the number of lamps in use at one time. It takes but a few seconds to change a lamp from one spot to another; and where required extra lengths of flexible wires are provided, with couplings at each end, so as to lead a lamp to a distant point. The lamps at the plats are not joined to the branch leads, but direct and through its own cut-out to the main wires. Thus any interference owing to an accident or fault to any of the leads in the levels will not affect the platlights, which are important ones to keep constantly alight.

By using leather washers for the covers of the junction-boxes and lamps, it will be seen that the whole system is waterproof, and that the lights will burn, even though the mine should be flooded and the conductors and lamps be under water.

This is a matter of the utmost importance for alluvial workings, where accidents from the inrush of water are by no means unfrequent. In such cases the value of having a light which cannot be extinguished should be highly estimated.

Another important use for the electric light is at the brace, where the light is exposed to the weather. In the case of kerosene lamps, on a stormy night it is very difficult to keep them alight, and then only at the expense of several chimneys.

The electric lamp at the brace is enclosed in a lantern, having a reflector to throw the light on the ropes and skip only, and controlled by a cut-out and switch fixed in a convenient part of the brace. Twelve months' experience with the working of the light at one of the Sandhurst mines has proved conclusively that with the precautions before mentioned no difficulty whatever can arise in any part of the system, and that the incandescent lamp is more economical, reliable, and affords a better illumination than any other available method.